ChemPhysChem 2018 vol.19 N11, pages 1344-1348

On the Solvation Behavior of Graphene Oxide in Ethylene Glycol/Water Mixtures

Neklyudov V., Agieienko V., Ziganshin M., Dimiev A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

 The self-association and solvation pattern of graphene oxide (GO) in water, ethylene glycol (EG), and their mixtures were analyzed by means of UV/Vis spectrophotometry. A careful analysis of the absorbance dependencies vs. the GO concentration shows that self-association of the GO sheets in EG occurs at higher concentration compared to that in water. It was established that depending on the mixed solvent composition, two different types of the GO solvates are formed. The results of quantum chemical calculations allow one to suggest that in the water-rich compositions, the GO oxygen-containing groups are in direct contact with water molecules while in the glycol-rich media the EG molecules fully substitute water in the GO's first solvation layer.

http://dx.doi.org/10.1002/cphc.201800042

Keywords

ethylene glycol, graphene oxide, quantum chemical calculations, solvation, UV/Vis spectrophotometry

References

[1] S. Stankovich, D. A. Dikin, R. D. Piner, K. A. Kohlhaas, A. Kleinhammes, Y. Jia, Y. Wu, S. T. Nguyen, R. S. Ruoff, Carbon 2007, 45, 1558–1565.
[2] S. Pei, H.-M. Cheng, Carbon 2012, 50, 3210–3228.
[3] M. M. Gudarzi, Langmuir 2016, 32, 5058–5068.
[4] J. I. Paredes, S. Villar-Rodil, A. Martínez-Alonso, J. M. D. Tascón, Langmuir 2008, 24, 10560–10564.
[5] V. V. Neklyudov, N. R. Khafizov, I. A. Sedov, A. M. Dimiev, Phys. Chem. Chem. Phys. 2017, 19, 17000–17008.
[6] D. Konios, M. M. Stylianakis, E. Stratakis, E. Kymakis, J. Colloid Interface Sci. 2014, 430, 108–112.
[7] M. M. Gudarzi, M. H. M. Moghadam, F. Sharif, Carbon 2013, 64, 403–415.
[8] H. Wang, Q. Hao, X. Yang, L. Lu, X. Wang, Nanoscale 2010, 2, 2164–2170.
[9] J. Wu, X. Shen, L. Jiang, K. Wang, K. Chen, Appl. Surf. Sci. 2010, 256, 2826–2830.
[10] L. Lai, L. Chen, D. Zhan, L. Sun, J. Liu, S. H. Lim, C. K. Poh, Z. Shen, J. Lin, Carbon 2011, 49, 3250–3257.
[11] B. Wang, J. Park, C. Wang, H. Ahn, G. Wang, Electrochim. Acta 2010, 55, 6812–6817.
[12] C. Xu, R.-s. Yuan, X. Wang, New Carbon Materials 2014, 29, 61–66.
[13] M. M. Heyhat, S. Kimiagar, N. Ghanbaryan Sani Gasem Abad, E. Feyzi, Phys. Chem. Res. 2016, 4, 407–415.
[14] R. R. Amirov, J. Shayimova, Z. Nasirova, A. M. Dimiev, Carbon 2017, 116, 356–365.
[15] Q. Lai, S. Zhu, X. Luo, M. Zou, S. Huang, AIP Adv. 2012, 2, 032146.
[16] R. M. Wallace, J. Phys. Chem. 1960, 64, 899–901.

[17] R. M. Wallace, S. M. Katz, J. Phys. Chem. 1964, 68, 3890–3892.

[18] C. Galande, A. D. Mohite, A. V. Naumov, W. Gao, L. Ci, A. Ajayan, H. Gao, A. Srivastava, R. B. Weisman, P. M. Ajayan, Sci. Rep. 2011, 1, 85.1-85.5.

[19] X.-F. Zhang, X. Shao, S. Liu, J. Phys. Chem. A 2012, 116, 7308–7313.

[20] D. W. Boukhvalov, M. I. Katsnelson, J. Am. Chem. Soc. 2008, 130, 10697–10701.

[21] J.-A. Yan, M. Y. Chou, Phys. Rev.B 2010, 82, 125403.1-125403.10.

[22] J.-A. Yan, L. Xian, M. Y. Chou, Phys. Rev. Lett. 2009, 103, 086802.1-086802.4.

[23] A. Lerf, H. He, M. Forster, J. Klinowski, J. Phys. Chem. B 1998, 102, 4477–4482.

[24] H. He, J. Klinowski, M. Forster, A. Lerf, Chem. Phys. Lett. 1998, 287, 53–56.

[25] L. Wang, Y. Y. Sun, K. Lee, D. West, Z. F. Chen, J. J. Zhao, S. B. Zhang, Phys. Rev. B 2010, 82, 161406.1-161406.4.

[26] D. Lee, J. Seo, Sci. Rep. 2014, 4, 7419.1-7419.6.

[27] H. Geng, X. Liu, G. Shi, G. Bai, J. Ma, J. Chen, Z. Wu, Y. Song, H. Fang, J. Wang, Angew. Chem. Int. Ed. 2017, 56, 997–1001,

[28] Angew. Chem. 2017, 129, 1017–1021.

[29] W. Du, M. Wu, M. Zhang, G. Xu, T. Gao, L. Qian, X. Yu, F. Chi, C. Li, G. Shi, Chem. Commun. 2017, 53, 11005–11007.